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Environmental and Economic Impact Statement, Noise Emission Regulations for Truck-Mounted Solid Waste Compactors

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Environmental and Economic Impact Statement

Final

Noise Emission Regulations for Truck-Mounted Solid Waste Compactors

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16. ABSTRACT

This document presents an assessment of the expected environmental benefits and economic effects of the Noise Emission Regulations for Truck-Mounted Solid Waste Compactors. The information presented includes the statutory basis for the action, a summary of the regulation, a description of the existing truck-mounted solid waste compactor environment, the alternatives considered, the expected environmental benefits, the expected economic effects, and conclusions.

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FINAL
ENVIRONMENTAL AND ECONOMIC IMPACT STATEMENT

NOISE EMISSION REGULATIONS FOR TRUCK-MOUNTED SOLID WASTE COMPACTORS

August 1979

U.S. Environmental Protection Agency
Office of Noise Abatement and Control
Washington, D.C. 20460

This document has been approved for general availability.
It does not constitute a standard, specification, or regulation.

SUMMARY

Agency: U.S. Environmental Protection Agency
Office of Noise Abatement and Control (EPA/ONAC)

Action: Notice of Rulemaking (NRM) to establish noise emission limits for newly-manufactured truck-mounted solid waste compactors (TMSWC).

Description:

1. Truck-mounted solid waste compactors (refuse collection vehicles) manufactured after October 1, 1980 shall not emit a noise level (A-weighted) in excess of 79 decibels (the energy average of measurements made at four positions around the truck, at a distance of 7 meters from the vehicle surface, with the vehicle stationary, empty and operating through its compacting cycle at the maximum engine speed allowable for compaction). The not-to-exceed noise level is reduced to 76 decibels for vehicles manufactured after January 1, 1982.

2. The regulation requires that the manufacturer design and build each product so that its noise level will not degrade (increase) above the applicable level for a period (the Acoustical Assurance Period, or AAP) of 2 years or 5000 operating hours after delivery to the ultimate purchaser.

3. The regulation specifies a Low Noise Emission Product (LNEP) level of 71 decibels, effective October 1, 1979.

4. The regulation incorporates an enforcement program modeled after the enforcement provisions in the existing medium and heavy truck noise regulation. This program includes production verification, selective enforcement auditing, warranty, maintenance, compliance labeling, and antitampering provisions.

Benefits:

1. A 70 percent decrease is expected in the population exposed to noise levels above a yearly L_{dn} of 55 dB due to truck-mounted solid waste compactors.

2. A 74 percent reduction is expected in the severity and extent of annoyance and general adverse response to noise from compactor vehicles.

3. A 75-80% reduction is expected in the potential occurrence of sleep disturbances, sleep awakenings, and other activity interferences such as speech interference due to compactor vehicle noise.

4. An annual fuel savings of 2 million gallons of gasoline and 1.2 million gallons of diesel fuel is anticipated when the entire refuse collection vehicle fleet is in compliance.

Impacts:

1. The average list price of refuse collection vehicles may increase by 10.3 percent, based on the combined cost of compactor and chassis.

2. Demand for new truck-mounted solid waste compactors could decrease by as much as 2 percent, but total manufacturer revenue should remain unchanged due to increased prices.

3. The annualized cost to the collection industry is estimated to be approximately $21.5 million. This translates to an annual cost of less than 10 cents per person served in the United States.

4. Costs are expected to be passed through to the consumer and should cause an increase in annual residential refuse collection costs of no more than 50 cents per household served.

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FINAL
ENVIRONMENTAL AND ECONOMIC IMPACT STATEMENT

NOISE EMISSION REGULATIONS FOR TRUCK-MOUNTED SOLID WASTE COMPACTORS

INTRODUCTION

The U.S. Environmental Protection Agency (EPA) has issued a noise emission regulation for newly-manufactured truck-mounted solid waste compactors. This regulation is intended to alleviate the adverse health and welfare impacts on people, resulting from the noise of refuse compaction in residential neighborhoods.

This Environmental and Economic Impact Statement (EEIS) presents, in summary form, the benefits to be gained from the truck-mounted solid waste compactor noise standards, and the economic implications of this action. Also presented are the principal regulatory options which were considered by EPA. The information contained in this document addresses the principal issues involved with this rulemaking and EPA's continuing activities in promoting a quieter environment for all Americans.

REGULATORY ANALYSIS

In arriving at the not-to-exceed noise standards for new refuse collection vehicles, the Agency considered various regulatory options in the light of available quieting technology, potential health and welfare benefits, and the attendant costs and economic effects of compliance with each option. The regulatory decisions involved in the rule were based on technical data and other information gathered by EPA from meetings with manufacturers, distributors and users, and from published data and public comments. This information has been

compiled and analyzed by EPA, and published in the form of a regulatory analysis entitled, "Regulatory Analysis of the Noise Emission Regulations for Truck-Mounted Solid Waste Compactors," (EPA 550/9-79-257). This document may be obtained upon request from:

Mr. Charles Mooney
EPA Public Information Center (PM-215)
U.S. Environmental Protection Agency
Washington, D.C. 20460

For the sake of brevity and simplicity the information contained in this EEIS is presented in summary form only. Persons wishing more detailed explanation and discussion of the facts and issues pertinent to the truck-mounted solid waste compactor noise rulemaking are encouraged to refer to the regulatory analysis.

The preamble and text of the regulation and additional copies of this EEIS can also be obtained from the above address.

ADDITIONAL INFORMATION

For further information related to the regulation, please contact:

Mr. Fred Mintz
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Office of Noise Abatement and Control (ANR-490)
U.S. Environmental Protection Agency
Washington, D.C. 20460
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STATUTORY BASIS FOR ACTION

Congress passed the Noise Control Act (NCA) of 1972 (Public Law 92-574), in part, as a result of their findings that inadequately controlled noise presents a growing danger to the health and welfare of the nation's population, particularly in urban areas. Through the NCA, the Congress established a national policy to "promote an environment for all Americans free from noise that jeopardizes their health or welfare". In pursuit of that policy, Congress stated in Section 2 of the Act that "while primary responsibility for control of noise rests with state and local governments, Federal action is essential to deal with major noise sources in commerce, control of which requires national uniformity of treatment." As part of this essential Federal action, Subsection 5(b)(1) of the Act requires that the Administrator of the U.S. Environmental Protection Agency, after consultation with the appropriate Federal agencies, publish a report or series of reports "identifying products (or classes of products) which in his judgement are major sources of noise." Section 6 of the Act requires the Administrator to publish proposed regulations for each product identified as a major source of noise and for which, in his judgement, noise standards are feasible. Such products fall into various categories, one of which is surface transportation equipment.

Inasmuch as a number of different types of transportation equipment operate at the same time, the quieting of one product type is often not in itself sufficient to adequately reduce transportation noise to a level necessary to protect public health or welfare. Accordingly, the EPA's noise regulatory program has developed a coordinated approach to controlling overall transportation noise in which various types of transportation equipment, alone or in combination, are evaluated to assess their contribution to transportation noise and its impact on the nation's population.

Under the mandate of the Noise Control Act and EPA's approach to the control of transportation noise, noise emission regulations were promulgated on March 31, 1976, for medium and heavy trucks (41 FR 15538). These regulations, however, only apply to trucks when they are in a pass-by mode. As long as a truck is standing still, for example to collect and compact refuse, the noise emission regulations for medium and heavy trucks do not apply.

In order to address this problem and to further control transportation noise, in accordance with Subsection 5(b)(1) of the Noise Control Act the Administrator published a report on May 28, 1975 (40 FR 23105) that identified truck-mounted solid waste compactors as a major source of noise. A Notice of Proposed Rulemaking (NPRM) to regulate noise emissions from truck-mounted solid waste compactors was published on August 26, 1977 (42 FR 43226). Public comment was solicited for 90 days and two public hearings were held (New York City on October 18, 1977, and Salt Lake City, Utah, on October 20, 1977). A detailed review and consideration of the comments that were received has been carried out prior to the issuance of the final rule.

The final regulation is intended to alleviate the adverse health and welfare impacts of the noise of refuse collection and compaction on people in areas at or near their residences. The regulation is also intended to establish a uniform national noise standard for truck-mounted solid waste compactors distributed in commerce, thereby eliminating inconsistent state and local noise source emission regulations that may impose an undue burden on the truck-mounted solid waste compactor manufacturer and user industries.

SUMMARY OF THE REGULATION

The regulation establishes standards for noise emissions resulting from the operation of newly-manufactured truck-mounted solid waste compactors. The standard specifies that those noise emissions shall be described in terms

of the energy-averaged A-weighted sound pressure level in dB, measured at a distance of 7 meters (approximately 23 feet) from the front, rear, and side surfaces of the truck-mounted solid waste compactor vehicle, using "slow" meter response. For test purposes, the vehicle is stationary, empty, and operated through its compacting cycle at the maximum engine speed allowable for compaction.

To minimize market impacts from substitution of unregulated vehicles, identical effective dates were set for all types of compactor vehicles subject to the standards. Effective on the dates listed below, truck-mounted solid waste compactor vehicles must not produce noise levels in excess of the levels shown, when operated and evaluated according to the methodology provided in the regulation.

Regulatory Noise Emission Standards

Effective Date	Not-to-Exceed Noise Level
October 1, 1980	79 decibels
July 1, 1982	76 decibels

The EPA believes that the estimated health and welfare benefits from this regulation can be attained only if the compactors conform to the prescribed noise levels for a reasonable period of time. Therefore, in order to ensure the realization of benefits from this regulation, the Agency requires that manufacturers design and build each product so that, when properly maintained and used, its noise level will not degrade (increase) above the applicable level for a specified period of time or use, from the date of the product's delivery to the ultimate purchaser. This period is called the Acoustical Assurance Period (AAP). In the case of truck-mounted solid waste compactors, the Acoustical Assurance Period is two years or 5000 operating hours, whichever occurs first. If a manufacturer anticipates that the noise level of his product will increase

during the AAP, then he must take into account this anticipated increase in noise level, termed the Noise Level Degradation Factor (NLDF), when making test measurements to show compliance with the applicable standard. He must demonstrate that his product's noise level does not exceed an amount equal to the regulatory level less the NLDF value.

Under the authority of Section 15 of the Noise Control Act, the regulation specifies a Low Noise Emission Product (LNEP) level of 71 dB determined by the measurement methodology prescribed in the standard, effective October 1, 1979. That is, for a product to be qualified as a LNEP, its noise level must not exceed 71 dB. The LNEP program provides manufacturers with incentives for reducing the noise level of their products below the regulated noise level. The Federal government is authorized to purchase LNEPs in lieu of those like products which just meet the regulated levels. The Federal government is further authorized to pay up to a twenty-five percent premium over the retail price of the least expensive product of like type.

The regulation also incorporates an enforcement program which includes production verification, selective enforcement auditing, warranty, maintenance, compliance labeling and antitampering provisions. Production verification means that prior to the distribution into commerce of any truck-mounted solid waste compactor vehicle, a manufacturer must submit information to EPA which demonstrates that his product conforms to the standards. Selective enforcement auditing means that in response to an administrative request, a statistical sample of truck-mounted solid waste compactors must be tested to determine if the units, as they are produced, meet the standard.

EPA wishes to avoid placing an excessive testing burden on distributors who assemble a compactor vehicle by mounting a compactor body on a truck chassis. These distributors (who are "manufacturers" under the Noise Control Act and therefore are otherwise subject to all provisions of the regulation) are permitted to rely on the production verification tests of the compactor

body manufacturer if the distributor faithfully follows assembly instructions provided by the compactor body manufacturer.

Current Federal regulations applicable to truck chassis noise are the EPA Noise Emission Standards for Motor Carriers Engaged in Interstate Commerce (39 FR 38208) and the EPA Noise Emission Standards for Medium and Heavy Trucks (41 FR 15538). The U.S. Bureau of Motor Carrier Safety of the U.S. Department of Transportation has issued regulations for the purpose of establishing measurement procedures and methodologies for determining whether in-use commercial motor vehicles conform to the Federal Interstate Motor Carrier Noise Emission Standards.

Under the authority of the Noise Control Act of 1972 this regulation establishes a uniform national standard for newly-manufactured truck-mounted solid waste compactor vehicles that preempts, after its effective date, all state and local new source emission regulations that are not identical with the Federal regulation.

However, since primary responsibility for control of noise rests with state and local governments, nothing in the Act or this regulation precludes or denies the right of any state or political subdivision from establishing and enforcing controls on environmental noise through the licensing, regulation or restriction of the use, operation or movement of any product or combination of products. Furthermore, Section 6(f) of the Act, as amended, gives a state or political subdivision the right to petition the Administrator of EPA to revise the standard on the grounds that a more stringent standard is necessary to protect the public health and welfare.

The noise controls which are reserved to state and local authority include, but are not limited to, the following:

1. Control on the manner of operation of products
2. Controls on the time of day during which products may be operated
3. Controls on the places in which products may be operated

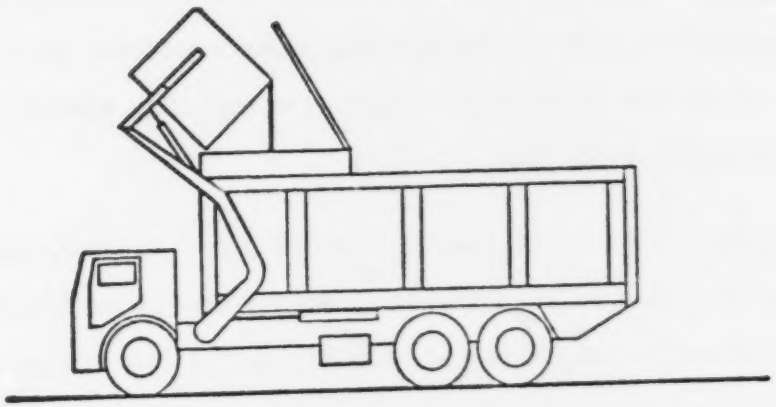
4. Controls on the number of products which may be operated together
5. Controls on noise emissions from the property on which products are used
6. Controls on the licensing of products
7. Controls on environmental noise levels.

By use of the noise controls reserved to them, state and local governments will be able to supplement Federal noise emission standards and to effect near term relief from truck-mounted solid waste compactor noise.

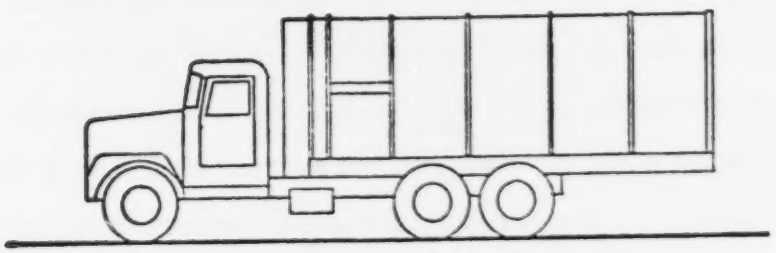
THE EXISTING TRUCK-MOUNTED SOLID WASTE COMPACTOR ENVIRONMENT

A truck-mounted solid waste compactor is defined, for purposes of this regulation, as a vehicle that is comprised of a mechanically powered truck cab and chassis or trailer, and equipped with a body and machinery for receiving, compacting, transporting, and unloading solid waste. The body, which includes a waste-receiving hopper, houses machinery which typically consists of hydraulic actuators (rams) with the necessary hydraulic pump(s), valves, piping, and controls and auxiliary engines, where used. The hydraulic actuators operate various components that sweep the waste matter into the container portion of the body and compact it. Power generally is drawn from the truck engine by means of a power take-off (PTO) unit that is coupled by gears or other mechanical connection to the transmission, engine drive shaft, or fly wheel. Auxiliary gasoline or diesel engines may be used in place of the truck engine and PTO.

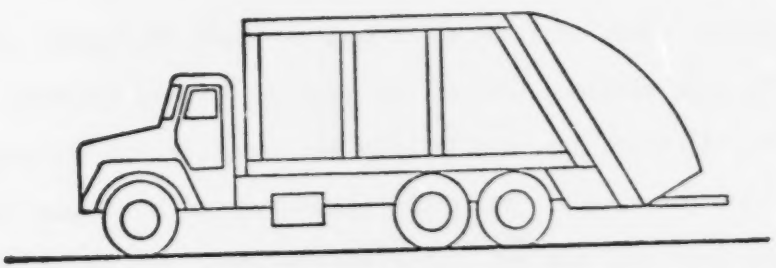
Figure 1 shows line drawings of a front loader, a side loader and a rear loader. Details regarding identification of these machines as candidates for regulation, their design features and functional characteristics are contained in the regulatory analysis, "Regulatory Analysis of the Noise Emission Regulations for Truck-Mounted Solid Waste Compactors."



Front Loader



Side Loader



Rear Loader

Figure 1

Types of Truck-Mounted Solid Waste Compactors

The following are the major types of truck-mounted solid waste compactors:

1. Front Loader This type of compactor body utilizes front mounted hydraulic lift arms to lift and dump waste containers into an access door in the top of the body. Wastes are typically ejected through the tailgate of the body.

2. Side Loader Side loader compactor bodies vary. However, wastes are generally deposited manually into a hopper through an access door in the side wall. Packer plates sweep the wastes from the hopper into the body and compress the materials against an interior wall in the same manner as front loaders. Some side loaders are equipped to hydraulically lift and dump waste containers. Ejection of wastes is usually through a tailgate in the body. Some side loader models do not use their packer plate for ejection, but rather hydraulically lift the front end of the body and dump the waste through the tailgate in much the same fashion as a dump truck.

3. Rear Loader This is a compactor body on which the hopper is located on the rear section. Wastes are generally loaded manually into the hopper, although some models have the capability to hydraulically lift and dump containers. The packer plate sweeps the wastes from the hopper into the body and compresses the waste against an interior wall surface. In most models, a hydraulically driven plate is used for tailgate waste ejection.

Based on noise measurements conducted by, and on behalf of, the Environmental Protection Agency, energy-averaged A-weighted sound pressure levels of today's truck-mounted solid waste compactors were found to range from 74 to 92

decibels at seven meters. However, EPA's studies revealed that approximately ten percent of all newly-manufactured compactor vehicles currently incorporate some degree of intentional quieting. The noise levels of these "quieted" vehicles range from 74 to 85 decibels. It is estimated however, that 80% of the current compactor vehicle fleet have noise levels in excess of 80 decibels.

The Environmental Protection Agency has identified a yearly L_{dn} of 55 dB as the environmental noise level requisite to protect public health and welfare with an adequate margin of safety; L_{dn} being the Day-Night Sound Level which is the A-weighted equivalent sound level for a 24-hour period with an additional 10 dB weighting imposed on the equivalent sound levels occurring during nighttime hours (10 p.m. to 7 a.m.). The current compactor vehicle fleet on U.S. city streets comprises more than 80,000 vehicles. Because of their numbers and noise levels it is estimated that approximately 19.7 million people are exposed to environmental noise levels in excess of a yearly L_{dn} of 55 dB due to these vehicles. These levels are high enough to jeopardize the health or welfare of those 19.7 million people by causing general annoyance, interference with speech communication and other social activities, and sleep disturbance and awakening.

In suburban single-family residential areas, refuse collection events occur once or twice a week and are frequently brief in duration. Consequently, they make only a modest contribution to the overall suburban area environmental noise. However, the situation is quite different in high-density urban areas. Here, the refuse collection process is repetitious with the vehicle standing in one place for periods as great as 30 minutes, several times a week, because of the amount of refuse generated in a relatively small area. Frequently this

collection occurs during the night and very early morning hours to minimize traffic problems. Therefore the bulk of the environmental noise impact, in terms of general annoyance, activity interference, and sleep disruption, occurs in such densely populated areas.

Nevertheless, significant impact, in the form of individual intrusive events, also is caused by refuse collection in less densely populated residential areas. In such areas, the noise of compaction stands out above the relatively low ambient environmental noise levels, being sufficiently intense to cause incidents of general annoyance, sleep disturbance and other activity interference for many persons in medium and low density areas.

These single event noise intrusions become particularly important in light of other regulations and efforts to reduce the noise from other urban noise sources. Without a reduction in emissions from refuse compactors, these units may very well stand out as one of the more intrusive noise sources in our environment.

ALTERNATIVES CONSIDERED

Section 6 of the Noise Control Act of 1972 requires the Administrator to set regulations for each product which he has identified under Subsection 5(b)(1) of the Act as a major source of noise and for which noise emission standards are feasible. Specialty auxiliary equipment on trucks (of which truck-mounted solid waste compactors are one category) was identified as a major source of noise on May 28, 1975 (40 FR 23069).

Following this identification, comprehensive studies were performed to evaluate truck-mounted solid waste compactor noise emission levels necessary to protect the public health and welfare, taking into account the magnitude

and condition of use, the degree of noise reduction achievable through application of the best available technology, and the cost of compliance. The Agency carried out detailed investigations of compactor design, manufacturing and assembly processes, noise measurement methodologies, available noise control technology, costs attendant to noise control methods, costs to test machines for compliance, costs of recordkeeping, possible economic impacts, and the potential environmental and health and welfare benefits associated with the application of various noise control measures.

The results of the Agency's studies show that the regulation of truck-mounted solid waste compactor noise is feasible through the application of available noise control technology taking cost of compliance into account. This has been amply demonstrated by the wide-spread use of quiet refuse collection vehicles in a number of communities including New York City, San Diego, California, and San Francisco, California. The Exhibits at the end of this document contain an article that describes the quiet San Diego refuse collection fleet and an advertisement for a quiet refuse collection vehicle. Both of these exhibits were drawn from trade journals and exemplify the feasibility of noise emission standards for newly-manufactured truck-mounted solid waste compactors.

In addition, no evidence has been received to indicate that truck-mounted solid waste compactors are no longer a major noise source. Therefore, based on the requirements of the Noise Control Act, the Administrator must issue a new-product noise emission regulation.

Within the context of the Noise Control Act, the only alternative open to the Administrator is the selection of the specific regulatory scheme. A

range of regulatory levels and effective dates were considered by the Agency in the formulation of the NPRM. The final regulatory levels and effective dates were chosen on the basis of maximum benefits and minimal adverse economic effects. The Agency concluded that reducing the noise limits below values established by this regulation would provide only marginal gains in benefits, considering the other noises (not susceptible to Federal control) that are associated with refuse collection activities.

Several examples of other regulatory options that were considered are given below:

- Not-to-exceed noise level of 71 dB in 1982 - We estimate that this option would have provided a further decrease in adverse impact of only six percent from that offered by the 76 dB standard. In light of present day noise control technology, it was highly likely that this option would have precluded the near term use of diesel powered truck chassis.
- Not-to-exceed noise level of 74 dB in 1982 - This option was estimated to yield an additional four percent decrease in the severity and extent of impact from that offered by the 76 dB standard. In order for truck-mounted solid waste compactors to meet a 74 dB standard, it was estimated that the noise level of the truck chassis would probably need to be less than 79 dB as determined by the pass-by noise test procedure of the current Federal regulation for medium and heavy trucks. The present Federal noise standard for trucks over 10,000 pounds is 80 dB in 1982. It should be noted that, in this pass-by test, the truck engine is operating at maximum rated speed, and the noise measurement is made at a distance of 50 feet (15 meters). The noise measurement for the

truck-mounted solid waste compactor vehicle is made at a distance of seven (7) meters, and the truck engine is expected to be operating at a relatively low speed (since reducing engine speed is the most cost-effective way of reducing the noise emissions). Therefore, the noise levels for the two types of tests are not directly comparable.

- Based on the existing Federal truck chassis pass-by noise regulation of 80 dB in 1982, the best achievable standard for a compactor mounted on a diesel chassis would be 75 dB. This would reduce the environmental noise impact by two percent more than a 76 dB standard. However, such a regulation would require the use of a quiet hydraulic pump which is not expected to be available in production quantities until a substantial market has developed. This would entail an estimated increase in annualized cost of eight (8) percent. The incremental costs would be less than one-third as effective in reducing noise impact as the costs estimated for the regulatory option.
- A less stringent standard, for example 80 dB in 1982, would provide a substantial reduction in noise impact at a relatively low cost. However, it is not a viable alternative because it does not represent the application of best available technology as required under the Noise Control Act.

The reliance on local curfews was advocated as a "no-cost" alternative to Federal noise emission standards by several commenters to the Notice of Proposed Rulemaking (NPRM), and thus deserves discussion. The Agency believes curfews simply serve to transfer some of the noise impact from nighttime hours to daytime hours. They are not a substitute for a noise emission standard that will reduce the total noise emission and thus the public exposure. In addition, curfews can only be implemented at the local level and thus do not provide national uniformity of treatment.

Although curfews are often represented as being cost-free, they can in reality be very costly by impairing the efficiency of refuse collection activity. In heavily concentrated metropolitan areas (where much of the noise impact of refuse collection occurs) a curfew often forces the refuse collection vehicles out onto the streets during times of greatest traffic congestion. This produces inefficiencies due to both lower productivity per unit time of the refuse crews and greater fuel demands, to say nothing of the impact on traffic flow in commercial areas. For example, a refuse collectors' trade association in Chicago estimates increased costs of operation, due to inefficiencies caused by a curfew in Chicago, at $50 per refuse collection vehicle per day; this includes an extended work day, a reduction in the vehicle loads per day, and increased fuel costs due to operations during peak traffic hours. For the estimated 2000 independent refuse collection vehicles in Chicago, this could represent a cost of $100,000 per day, or about $30 million annually. Even allowing for some exaggeration of the cost factor, this clearly indicates that a curfew is not cost free and quite probably is not cost effective.

Several commenters to the Notice of Proposed Rulemaking (NPRM) stated either that refuse container noise should be regulated as part of the standard or that refuse container noise should be regulated instead of noise from truck-mounted solid waste compactors. The Agency agrees that in some cases, container noise contributes substantially to refuse collection noise. However, its presence or absence does not diminish the beneficial effects of controlling compaction noise. Also, it does not appear feasible to regulate container noise by a national performance standard. Since container noise arises primarily from handling (or, sometimes, mishandling) by collection personnel, it is best controlled by local in-use regulation of permissible types of containers, e.g., plastic garbage containers or garbage bags.

Prescription of any in-use, operational controls is available to communities desiring further reduction of the noise impact from truck-mounted solid waste compactors.

ENVIRONMENTAL IMPACTS

Health and Welfare

Compliance with the Federal standards will, on the average, reduce noise emissions from truck-mounted solid waste compactors by 6.5 dB from present day levels. Compared to the noisier units in service today, some unit reductions will be 14 dB or more. The EPA estimates that approximately 19.7 million persons currently are exposed to residential neighborhood noise levels above the day-night sound level (L_{dn}) of 55 dB* due to the operation of truck-mounted solid waste compactors. The Agency believes that the entire refuse collection fleet will be in compliance with the noise standards by 1991. As a result, approximately six million persons will remain exposed to L_{dn} greater than 55 dB. This represents an approximate 70 percent decrease of the population exposed to levels exceeding that identified by EPA. However, the six million persons who still remain above the identified level will also receive benefits in the form of varying levels of reduction in their exposure.

The reduction in extent and severity of impact is also evaluated in terms of annoyance and general adverse response, as well as other effects due to individual noise events, such as sleep disturbance and activity interference. In order to assess the general adverse response and annoyance from these types of noise events, the Agency uses a fractional impact analysis technique. This technique involves evaluating the "level-weighted population " (LWP) exposed to a noise source and is illustrated in Figure 2. The computation of LWP

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* The agency has determined that an L_{dn} of 55 dB or lower is requisite for the protection of the public health and welfare with an adequate margin of safety. The basis for this determination is presented in the EPA publication, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety."

allows one to combine the number of people jeopardized by noise above an L_{dn} of 55 dB with the degree of impact at different noise levels. The circle in Figure 2 is a source which emits noise to a populated area. The various partial amounts of shading represent various degrees of partial impact by the noise. The partial impacts are summed to give the LWP. In this example, six people who are adversely affected by the noise (partially shaded) result in a "level weighted population" (LWP) of two (totally shaded).

EPA estimates that the "level-weighted population" will decrease from about 2,110,000 in the base year, 1976, to about 540,000 in 1991. The decrease in LWP from 2,110,000 to 540,000 represents approximately a 74 percent reduction of the impact in severity and extent of general adverse response (annoyance) to noise from truck-mounted solid waste compactors. Part of the estimated reduction in impact is due to the effect of recently promulgated noise standards for medium and heavy trucks. In 1991, the reduced truck noise alone will account for an estimated reduction of 630,000 in "level-weighted population" impacted by refuse collection noise. The balance of the estimated reduction, 940,000 in level-weighted population, is due entirely to the compactor noise regulation. This represents an improvement of approximately 149 percent over the benefits that are anticipated from refuse vehicles from the current Federal noise regulation for medium and heavy trucks.

The intrusive nature of the noise impact of refuse collection vehicles was assessed by the Agency through a single-event noise exposure analysis related to sleep awakening, sleep disturbance, and speech interference. The analysis confirmed that the noise emission regulation for truck-mounted solid waste compactors should result in an estimated 75-80% reduction in the occurrences of sleep disturbance, sleep awakening, and interference with other activities such as speech.

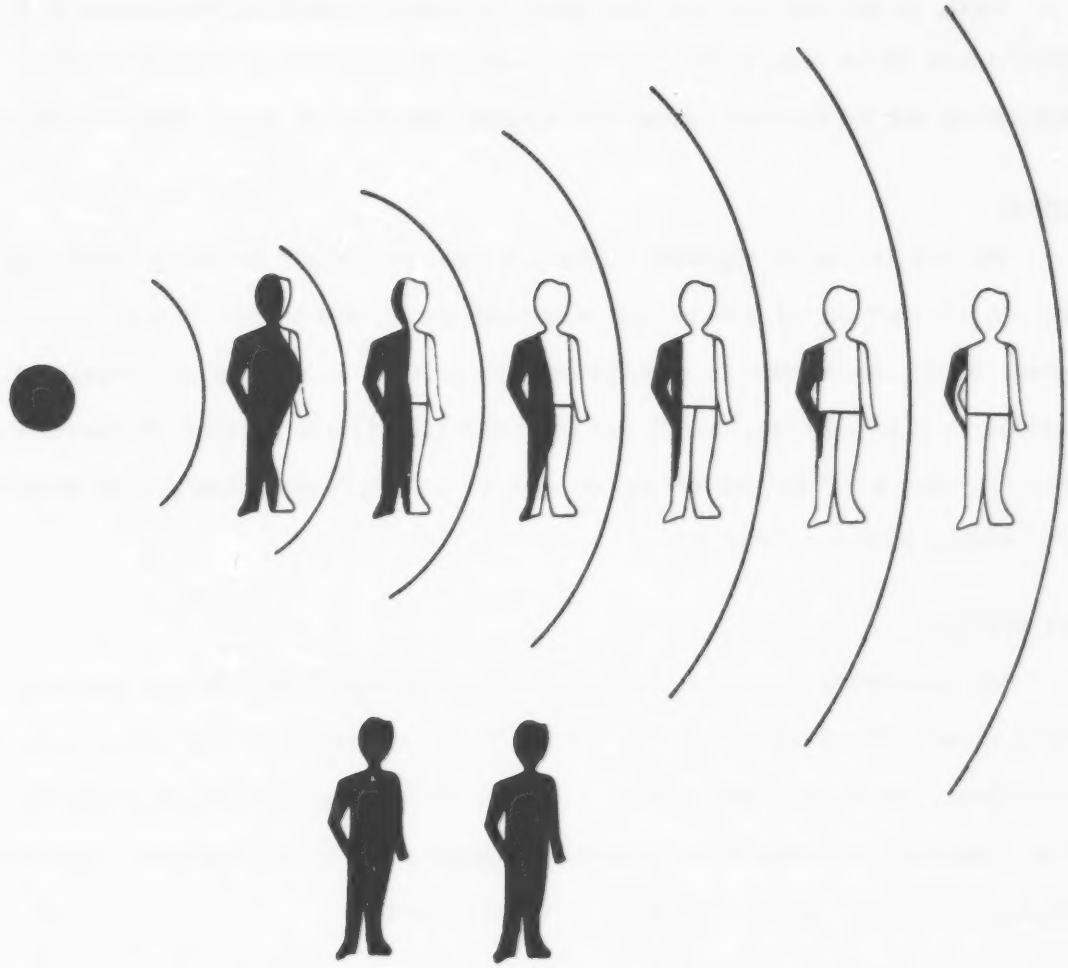

Figure 2

Level Weighted Population:
A Method to Account for the Extent and
Severity of Noise Impact

Thus, in conjunction with the benefits brought about by the medium and heavy truck noise regulation, the truck-mounted solid waste compactor noise regulation should provide health and welfare benefits of major proportions.

Energy

The regulation is expected to have a positive impact on energy resources. The anticipated use of slower engine speeds during compaction, a likely component of the noise control technology, is expected to produce an annual fuel savings of 2 million gallons of gasoline and 1.2 million gallons of diesel fuel when the entire refuse collection vehicle fleet has been replaced with vehicles that comply with the regulation.

Air Quality

The regulation is anticipated to have no adverse impact on air quality. Using slower engine speeds during compaction, a component of the noise control technology, could, in fact, result in a reduction in air pollutant emissions from compactor vehicles and a consequent improvement in air quality. However, the Agency has not quantified this potential benefit.

Land Use

There are potential benefits in the form of reduced noise exposure to residents in close proximity to land-fill areas. The same components used for refuse compaction during collection operations are used to expel the refuse from the compactor body. Considering that land-fill operations are generally continuous throughout the day with multiple unloading operations occurring simultaneously, the reduction in noise impacts on workers and residents could be substantial. The Agency has not quantified this potential benefit.

Water Quality

The regulation is expected to have no adverse impact on water quality or supply.

Solid Waste Disposal Requirements

No adverse effects on solid waste disposal requirements are expected due to the promulgation of the regulation.

Wildlife

The regulation is expected to have no adverse effects on wildlife. In fact, in rural collection areas and in areas where wildlife are in close proximity to land-fill areas, potential benefits are expected in the form of reduced noise exposure to the wildlife of those areas. The Agency has not quantified these potential benefits.

ECONOMIC IMPACTS

The establishment of noise standards for newly-manufactured truck-mounted solid waste compactors gives rise to expenditures which would otherwise not be directly incurred by the private and public sectors in the absence of curfews. However, noise pollution currently costs the American taxpayer many millions of dollars in hidden costs associated with decreased productivity, higher medical costs, and property value depreciation. One of the effects of a standard-setting, noise regulation is that, by reducing noise pollution, hidden costs are also reduced. However, visible costs are imposed on those responsible for the pollution. It should be understood that the option of not paying for noise pollution costs is unavailable. The only question is, in what form do we pay those costs?

Recognizing that certain expenditures are necessary to protect the public health and welfare from inadequately controlled noise, the Agency performed analyses to estimate the magnitude and potential impact of these expenditures.

Examined in the analyses were the structure of the industry, the estimated cost of abatement by compactor type, the price elasticity of demand, the capital and annual costs of enforcement, the impact of enforcement on annual operating and maintenance costs, and the indirect impacts of the proposed regulations.

Price

The cost impact of quieting compactors to meet the regulatory standard may be expressed in terms of increased list price. The Agency's studies indicate that average list price increases for the refuse collection vehicle can range from about 6.4 to 12.8 percent, depending on machine type and size (this estimated increase does not account for possible inflationary affects). This should result in an overall average list price increase of about 10.3 percent for the various combinations of compactor bodies and chassis-cab units. There are indications that a few small firms in the industry, by virtue of their small market share and related financial and operation factors, would incur higher manufacturing costs resulting in slightly higher list price increases. The price elasticity of demand, that is, the reduction in sales due to increased list price, for this equipment is estimated to be -0.2, or a possible decrease in sales of about 2 percent. However, the total revenue to the industry should not decrease as a result of price increases. In view of the current purchasing specifications of several major municipalities with respect to garbage truck noise level and their willingness to pay a premium for quiet trucks, a possible two percent decrease in demand must be considered a worst case impact.

Some pre-buying of unregulated refuse vehicles is expected to occur prior to the effective date(s) of the regulation. However, the Agency believes this activity will be limited to the available excess production capacity of the industry which is estimated at about 4,000 units, almost entirely rear loaders.

Capital Costs

Capital equipment costs represent a small portion (about five (5) percent) of the annual operating budget for the typical refuse collection and disposal firm. Consequently, the expected increase of about ten (10) percent in the list price of a compactor vehicle due to the regulation should result in increased operating costs of less than 0.5 percent (5% x 10%).

The increase in the annualized cost to the collector industry as a result of the implementation of this regulation is estimated to be $21.5 million. The Agency expects these costs to be totally passed through to the end user of waste collection services. The EPA estimates that, for residential refuse collection with costs in the range of $100 per household per year, the increase in annual cost per household served should be no more than 50 cents due to the promulgation of this regulation.

Maintenance and Operating Costs

Maintenance costs for compactor vehicles are expected to increase slightly due to the requirements of the regulation. This increase is expected to be on the order of $45 annually for front loaders and $78 annually for side and rear loaders. The maintenance cost increases for side and rear loaders are expected to be due largely to maintenance on the clutch of the added direct drive power take-off and on the impact reducing material added to the loading hoppers. Front loaders are assumed to employ a flywheel power take-off which will require no significant increase in maintenance costs. The increased maintenance costs for front loaders are expected, therefore, to be due largely to the expected maintenance on the impact reducing material added to the loading hoppers.

The changes in compactor operating conditions associated with the noise control treatment are expected to result in fuel savings due to the slower

speed of the engine. The estimated annual savings when the entire fleet is in compliance are expected to be about 2 million gallons of gasoline and 1.2 million gallons of diesel fuel. The savings due to reduced fuel usage are expected to be greater than the expected increase in maintenance costs. Due to the rapidly rising costs of both gasoline and diesel fuel, the net savings in operating costs, taking into account possible increases in maintenance costs, may be substantial.

Industry Structure

No significant change in industry profits is expected to occur over a 22 year period. Industry growth is not expected to be significantly impacted due to the noise abatement regulation. Adequate lead time has been provided to allow for proper planning and to avoid adverse conditions in the industry.

Suppliers

Some component suppliers may increase their sales depending on their ability to reduce the noise emissions of their products. This should contribute to the reduction in overall machine noise. Furthermore, those suppliers specializing in the manufacture of sound damping and sound absorptive materials and other products required for noise abatement would be expected to experience significant increased sales. The Agency has not quantified this benefit.

Employment

Employment is not expected to change significantly. Persons who might be affected by reduction of production due to the regulation amount to less than two percent of the industry's employee population of about 2900 persons. However, an offsetting increase in employment is expected to occur due to the new testing and compliance activity and procurement of noise control components and materials resulting from the regulation.

Exports and Imports

Since the noise control treatment generally represents add-on materials or substitute components or both, machines for export generally can be produced without noise control treatment. Units produced solely for export need not comply with U.S. noise standards. Consequently, the impact on exports should be minimal. However, all imported compactors will be subject to the regulation. Therefore, domestic and foreign manufacturers will be affected equally and no adverse competitive impact should result. Consequently, the regulation should have no appreciable impact on the U.S. balance of trade.

Macroeconomic Impacts

No macroeconomic impact is expected as a result of noise abatement regulations on the truck-mounted solid waste compactor body industry due to the minor size of the industry, and the low overall costs associated with this regulation.

Taxes

There may be an indirect increase in local taxes where collection services are provided by municipal fleets but the amount of the increase to the individual consumer and taxpayer is expected to be insignificant.

CONCLUSIONS

The Agency has concluded that at this time the regulatory levels and schedule promulgated represent adequate noise reduction standards for truck-mounted solid waste compactor vehicles. Implementation of the regulations is expected to result in a substantial reduction in the number of people impacted by compactor noise.

The technology to achieve the selected levels has been demonstrated.

The effective dates for the noise level limits are coordinated with existing Federal noise standards for medium and heavy trucks. The Agency believes that the time schedule for application of the noise standards, corresponding with reduced noise limits for trucks, should allow the manufacturers the lead time requisite to incorporate the necessary design and component changes without significant disruption to production or the marketplace.

The cost of compliance and possible economic effects have been considered and are believed to be reasonable.

EXHIBITS

Exhibit 1. MAXON Industries Advertisement for a Quiet Refuse Collection Vehicle (Source: Solid Waste Management. Vol. 21, No. 12, December 1978. pp. 44-45.)

Exhibit 2. "Silent Running - San Diego's RCV's". (Source: Commercial Car Journal. Vol. 135, No. 6, June 1978. pp. 161-164.)

MAXON EAGLE SL

Introducing . . .
The First Integrated Vehicle Ever Built for Refuse Collection

Now, for the first time – a vehicle engineered without compromise for the sole purpose of efficient, reliable refuse collection. It's called the Maxon Eagle SL – side loader body, refuse cab and chassis designed and built as a single unit system – the complete vehicle, ready now for delivery.

Every feature – suspension, braking, cooling, sound suppression, frame reinforcement, weight distribution, built-in dual drive, oversized window area, low 41" hopper, 11-second compaction cycle, instrumentation, service center, diagnostic test center – everything to the last detail specified to meet the rigorous demands of refuse service are included as standard equipment.

There's never been a vehicle like it before. And no hybrid body/chassis combination even comes close.

REFUSE CAB, CHASSIS AND SIDE LOADER BODY ENGINEERED & BUILT AS AN INTEGRATED SYSTEM

Low 41" Pitch-in Height

The lowest side-loading hopper in the industry. Made possible by the Eagle's integrated design, computer matching the packer body to the super-strong double-channel low frame.

Quiet
Continuous Loading Compaction with Front-Mounted Crankshaft Driven Pump

Everything about the Eagle is quiet. Sound suppression material in key areas of cab and body produce dBA readings even lower than future DOT standards.

Driver/operator can pack while loading, pack while moving to the next stop, without an auxiliary engine, without a noisy conventional PTO. The Eagle's 50,000 lb. packing ram and 17,000 lb crusher panel are powered by an exclusive crankshaft driven pump at a low 600 RPM.

All Weldable 60,000 PSI Frame

The Eagle SL frame is structurally reinforced at all critical load points with double channels under the packer body, extra cross members between the rails, and an extra tension member under the frame, increasing the RBM (Resistance to the Bending Moment) to 2,000,000 in/lbs per rail.

Maximum Maneuverability Top Operator Efficiency with Fully Integrated Dual Drive

The Maxon Eagle SL is much more than a "low cab forward truck." It's a side loader refuse truck with every component, every design feature matched to its total vehicle function.

Complete integration of right/left steering geometry provides maximum maneuverability and ease of operation with power steering cylinders on both sides of the front axle.

Step up is just 18" on the right for easy entry and exit. The right side driving position is built in as part of the overall Eagle SL design, not "add-on" equipment. The operator remains completely inside the cab for maximum visibility and protection from passing objects.

The Eagle SL operator, working alone, can consistently collect routes of 500-800 homes per day in less time than 2- or 3-man rearloader crews.

Cab, hopper and containers are within a few steps of one another at every stop. Pick up time per stop ranges from 15-30 seconds.

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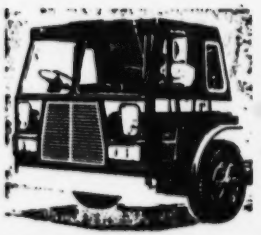
Rustproof Cab 6 Times Stronger than All Steel Cabs

That's right, it's fiberglass – all fiberglass, not just doors or roof. Molded over a steel frame in 2 complete fiberglass shells with 1" of high absorption insulation material between. The entire structure is equal in strength to 3/16" steel (that's 6x stronger than any of today's all-steel cabs). It won't rust, is completely fire retardant, sound responds sound as steel cabs do. It is easily repaired without losing structural integrity.

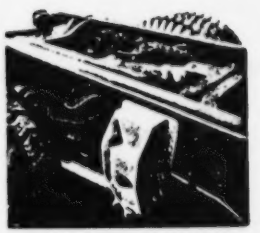
Unobstructed 7,000 Square Inch Window Area

Full width front windows, roll-down door window, auxiliary windows front and door – all completely unobstructed by dashboard, dog house, or any other interior equipment. The Eagle SL operator can see children, pets, traffic in places where even "city trucks" have blind spots.



Unequalled Cooling Efficiency

The Eagle SL's remarkable cooling system keeps it operating normally under start/stop conditions in ambient temperatures as high as 125°F. The 1200 sq. in. cross flow radiator has twice the core volume, double the water flow of other trucks in its class. A marine water pump, high efficiency fan and fan shrouding are built into the system as standard equipment.



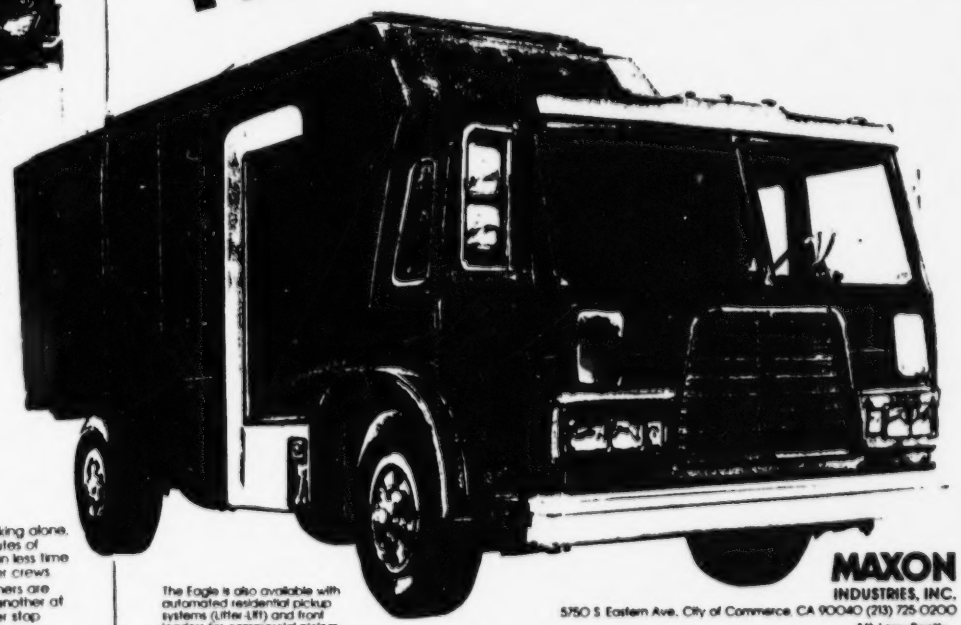
MAXON Triple Torque Rod Suspension

4 Times Stronger than Flat Leaf Systems. Solid hexagonal torque rods absorb the shocks of load shift during constant start/stop operation and eliminate spring wrap and shear forces on U-bolts. It's standard equipment on all single rear axle Eagle SL models.

NEW!

Write for **FREE** Brochure

and we'll send you a comprehensive guide to side loading refuse trucks and an informative EPA Study on one-man collection productivity, plus complete specifications on standard models of the Eagle SL.



The Eagle is also available with automated residential pickup systems (Litter-Lift) and front loaders for commercial pickup.

MAXON INDUSTRIES, INC.
5750 S. Eastern Ave., City of Commerce, CA 90040 (213) 725-0200
Att: Larry Beatty

EXHIBIT 1

EXHIBIT 2

SILENT RUNNING— San Diego's RCVs

Responding to pressure from city officials, San Diego's General Services Department engineers an RCV that makes noisy, grinding trash trucks a thing of the past.

By **BERT GOLDRATH**, *Field Editor*

■ Forget to put the trash out the night before collection? No matter, the grinding garbage truck—even several blocks away—can be a rousing reminder. Unless you live in San Diego where the newest refuse collection vehicles are tip-toeing down suburban streets, generating complaints from irate citizens who miss the noisy fanfare that once alerted them to trash time.

"Goes to show that you can't please everybody," said Robert Brown, department staff engineer who developed specifications for the hushed-up trash truck. He and others in the city's General Services Department worked closely with Master Truck, a local equipment manufacturer, to meet the 86 decibel noise limit established earlier by city ordinance.

"It's the quietest RCV that I know of," Brown said.

"A great deal of the 'old' noise came from an auxiliary diesel compactor engine. The main truck engine was wet sleeved and the auxiliary was air-cooled. With the two running simultaneously, the noise level easily reached an outrageous three figures. The trash collection industry," Brown added, "has not been overly noise conscious. At one time, we used a small pump and spun it fast with the auxiliary when compacting, which made even more noise. The main engine would operate at 1800 to 2800 rpm and the auxiliary at 2200 rpm."

In 1974, the San Diego city council passed a noise control ordinance which required major equipment changes in the trash fleet, Brown explained.

"My department promised to comply and guaranteed a new RCV with the lowest noise level package possible.

"We immediately knew the auxiliary engine would have to go. We laid down specifications for a new kind of vehicle and asked RCV manufacturers to give us a larger pump with a lower rpm that would still produce the required power. As an incentive to reduce the level of noise, we offered our only bidder an extra $400 for every reduced decibel. He responded with a unit that reduced engine rpm by 50%, dropping the noise level by close to 300%.

"In the end, it cost the city an extra $2000 per collection truck. But it was our choice, and I think it was worth it," Brown declared.

The city got the job done, working with a local firm, with city engi-

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RCVs

Above: Working with Master Truck, a local equipment manufacturer, San Diego's General Services Department developed one of the quietest refuse collection vehicles in the country. **Right:** Side cab view of the Leach 2R packer on a Master 20 yd chassis. Low door sill makes entry easier for the driver.

neers designing and engineering the truck from the ground up. But the General Services Department went beyond what city officials had asked, coming in with a truck that not only meets noise and pollution standards for today, but well into the future.

San Diego's General Services Department maintains a fleet of 86 vehicles that operate over 2200 miles of municipal streets. Operating five days a week, each truck averages 500 to 1000 miles a month. As environmental pressures increase, however, disposal sites available to San Diego as well as to hundreds of other U.S. cities become more remote and trash fleet mileage increases annually.

San Diego's RCV fleet includes 27 side-loaders, best for a one-man operation, and the balance is rear loaders with two-man crews. A few specialized front-end loaders are maintained for industrial use.

Brown projects that by the end of the present contract, at least 80% of the city's trash collecting fleet will be modern, low noise Master units. If he's right, San Diego will have more of these super-quiet trash trucks than any other city in the country.

"San Diego's first compactors were equipped with PTOs running off the front of the truck engine," Brown said.

Recalling the city's earlier experiences with those PTOs, Brown said that "at that stage of their development, there were several disadvantages: they were subject to overspeed, expensive pump or drive coupling assembly repairs, and were costly to maintain complicating the downtime problem. They also inhibited 'packing on the go.'

"Packing on the go is important when you make up to 600 stops per day," Brown said.

"Then we introduced the auxiliary diesel which produced the 50 or more horsepower needed for the hydraulic compaction system. This engine and its high revving pump were major sources of noise, especially without encapsulation. We began to phase out that type and started using a crankshaft-driven hydraulic pump to power the compaction-type body. That was an expensive decision. It's not practical to mount the pumps directly on the engine. Instead, the pumps were mounted to a frame cross member and driven by a coupling from the engine crankshaft. There was a mismatch," Brown said, "in vibration between the engine and the rigidly-mounted hydraulic pump. We began experiencing a high percentage of failures with different kinds of flexible drive couplings which couldn't be kept in alignment, nor effectively dampened from the induced vibration.

"Technology finally came to the rescue with the hot shift PTO. The system is always engaged so we can compact underway. There is a wet disc clutch drive to the output shaft of the PTO, and the driven gear of the PTO is always engaged to the driving gear of the transmission.

"It provides an acceptable drive

Operator Harold Steels stands at remote control console of a new Master/Able side loader RCVs "pack on the go," crucial for a stop and go operation.

mechanism in conjunction with the converter lockup kit. The engine is run at slightly over idle speed. On earlier PTOs, it was around 2200 rpm. Now it is usually 700 to 1000 rpm, with a maximum of 1400.

"We went from a 17 gallon-per-minute to a 69-gpm pump. It's a vital element in the system and worth the $800 to $1000 cost. Pump pressure ranges up to 2500 psi, but it can be adjusted to fill any hydraulic pressure demand we foresee," Brown explained.

"When we phased out the auxiliary engines, we saved 2.5 gallons of fuel per hour or about 60 gallons a week. That was a big item. The last auxiliaries we used were shale-out, air-cooled three-cylinder Deutz diesels.

Continued

RCVs

Above: Three generations of San Diego refuse trucks. Oldest is International (left), next came Master with slide-out engine (right), latest (center) is Master tilt cab.

"Since all of our RCV truck engines are diesel, we are well within emission standards. We have just retired the last of our gasoline engines—478-cubic inch V8s rated at 200 horsepower at 3400 rpm. Mated with the Allison MT-40 automatic transmission, they proved to be underpowered. Then we used the Cummins 180 governed at 2600 rpm which is now out of production. The story is the same with the International DV-550. The answer, for a while, came in the form of the Detroit Diesel 6V53. Its drawback was that in our application—lots of stop and go driving—it required a substantial amount of cooling. We were frying a lot of engines until Master came along with a six inch radiator core with a frontal area of 1250 inches.

"That should have solved all our power related problems, but now the 6V53 is no longer certified in California. We then settled on Detroit's inline 6-71, putting out 210 horsepower and 600 pound foot of torque. We teamed the Allison 654 transmission with the 6-71, and they have proved to be very compatible. We have avoided turbocharging because it could be prone to operator abuse.

"Cooling engines," Brown continued, "used to be our biggest headache, mainly because RCV service is so completely different from a linehaul operation. The nearest thing to it is a transit mixer service. Linehaul engines get a high volume of ram air, but our operation is practically all intra-city with very low mileage, low speed, high idle time and high stop frequency. All this can cause adverse effects on the power train. It is safe to say that the majority of RCV residential vehicles are plagued with cooling problems. In one 12-month period, we had 100% engine failures with our trash fleet because of over heating. That's $2500 in parts and labor per unit. And that's why it pays to pay a premium price for a new truck with an adequate cooling system," Brown said.

It was to keep equipment out of the shop that Brown and his management team elected to go the automatic Allison route. "It costs more initially, but the total overall life cost is less. The cost of clutch discs and pressure plates is astronomical with the number of stops required per day, per truck. Besides, we encounter some hills with grades of eight to 10%. The automatics shift themselves, the Allisons were chosen because they are the quietest available for our purpose."

San Diego's RCVs have no transfer cases and no four-wheel drive. The three-axle vehicles have two rear driving axles which are protected with spring-equipped parking brakes.

The old trash units had numerous leaf spring failures, caused mainly by maximum capacity loads. Using Hendrickson suspensions with 34,000-lb capacity was too light so the 38,000-lb was specified. The axle ratio is 4.56 to 1.

Another feature of these super-quiet trucks is the 96-in cab that provides extra room for crew convenience.

To reduce crew fatigue, spec's called for low cab step height and low pitch-in height for both side and rear-end loaders. Vertical height from ground to lip on the side-loaders was reduced to 42" from the usual 50. The manufacturer was inspired to achieve this design innovation by an incentive bonus of $200 for every inch shaved off the standard height. "It's worth it to us if only from a workmen's compensation point of view," Brown said. Rear loaders now have a minimum standard height of 36 in. to lessen crew labor and fatigue.

The San Diego experiment has been a blessing to environmentalists, but if noiseless RCVs catch on, city dwellers nationwide may learn to fall in love again with the strange silence of the all too familiar noisy neighborhood trash truck. □□□